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Case Report

Successful management of iatrogenic coronary arteriovenous fistula developed during chronic total occlusion intervention☆

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ABSTRACT

There have been some reports of iatrogenic coronary arteriovenous fistula (AVF) developing during percutaneous coronary intervention (PCI). PCI for chronic total occlusion (CTO) is more challenging due to a higher rate of procedural failure and increased risk of periprocedural complications. Recently, the coronary CTO guidewire has made rapid strides and revolutionized the procedure to increase high success rates for CTO revascularization. Simultaneously, as the number of CTO interventions increases, more complicated cases have also been reported.

We report a case of huge iatrogenic left circumflex artery-to-posterior vein of left ventricle fistula resulting from unexpected penetration of CTO guidewire into cardiac vein during CTO intervention, which was successfully closed by a covered stent. Although controversies still exist concerning the closure of iatrogenic AVF in asymptomatic patients, especially when it drains into a third space including cardiac chambers or venous system, we decided to perform the closure of iatrogenic AVF by covered stent due to relatively bigger AVF size which was generated immediately following balloon angioplasty.

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Introduction

Coronary arteriovenous fistula (AVF) may be congenital or acquired secondary to trauma or cardiac intervention. They are rare and primarily of congenital etiology. In the literature, there have been some reports of iatrogenic coronary AVF from percutaneous coronary intervention (PCI) [1–5]. PCI for chronic total occlusion (CTO) is more challenging due to a higher rate of procedural failure and increased risk of periprocedural complications. Recently, the coronary CTO guidewire has made rapid strides and revolutionized the procedure to increase the high success rates for CTO revascularization. Simultaneously, as the number of CTO interventions increased, more complicated cases have also been reported.

We report a case of huge iatrogenic left circumflex (LCX) artery-to-posterior vein of left ventricle (PVLV) fistula resulting from unexpected penetration of CTO guidewire into cardiac vein during CTO intervention, which was successfully closed by a covered stent. To our knowledge, this is the first reported case of an iatrogenic LCX-to-PVLV fistula formation resulting from penetration of guidewire into cardiac vein during CTO intervention.

Case report

A 75-year-old man was transferred for the evaluation and further management for effort chest pain. He was on antihypertensive medication for hypertension at a local clinic. The echocardiogram revealed severe hypokinesia of posterolateral wall with left ventricular ejection fraction of about 50% by modified Simpson's method. Coronary angiography showed typical CTO at mid-LCX artery with bridging collaterals grade 1 toward short distal LCX and obtuse marginal (OM) artery segments (Fig. 1). There was no significant stenosis at left anterior descending (LAD) artery and right coronary artery (RCA). We planned to perform elective PCI for LCX/OM CTO lesion.

A 6 French short (5 cm) sheath was inserted into right radial artery, and unfractionated heparin (5000 units) was initially administered. A 6 French Extra back-up guiding catheter was engaged into the left coronary artery. At first, recanalization of mid-LCX CTO lesion by Fielder XT™ (Asahi Intec, Japan) guidewire supported by PROWLER® microcatheter (Cordis Endovascular Systems, Miami Lakes, FL, USA) was attempted but failed. Next, the Miracle guidewire™ 6 g (Asahi Intec) was successfully negotiated into OM branch but not into distal-LCX artery. From the mid-LCX to OM branch, there was multiple sequential predilation with a 1.5 mm × 10 mm Amadeus Supercross® (Eurocor, Bonn, Germany) and a 2.0 mm × 15 mm Sapphire II® (OrbusNeich, An Hoevelaken,

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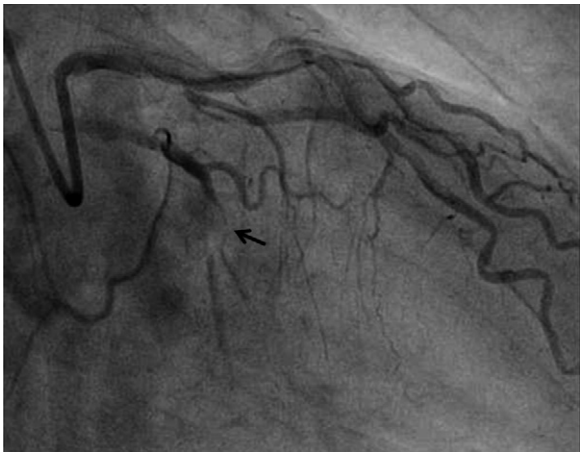

Figure 1. Coronary angiography showed chronic total occlusion at mid left circumflex (LCX) artery with bridging collaterals grade 1 to short segment of distal LCX and obtuse marginal artery (arrow).

Figure 2. Stent deployment with a 2.75 mm × 24 mm NOBORI™ was performed up to 10 atmospheres for 10 s. After stent deployment, distal left circumflex artery branch was still occluded (arrow).

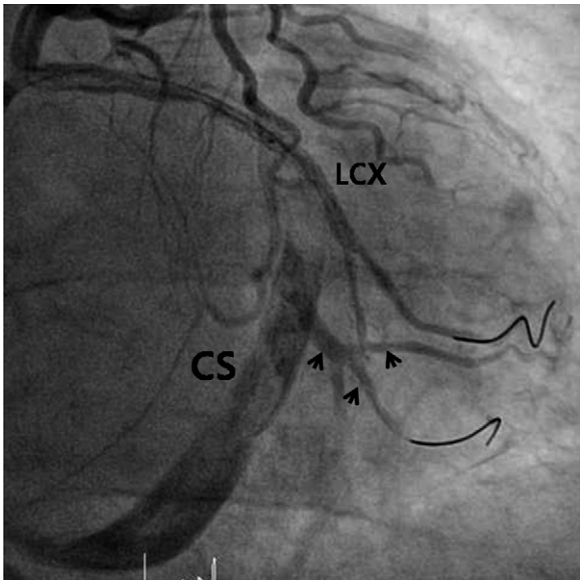

Figure 4. Cineangiogram showed the immediate formation of an arteriovenous fistula arising from the distal left circumflex (LCX) artery draining into coronary sinus (CS) via the posterior vein of left ventricle with side branches (arrows).

Netherlands), which were inflated to burst pressure. Subsequent stent deployment with a 2.75 mm × 24 mm NOBORI™ (Terumo Corporation, Tokyo, Japan) was successfully performed up to 10 atmospheres for 10 s without immediate complications. However, distal LCX branch was still occluded (Fig. 2).

We attempted several times to cross the CTO lesion in the distal LCX with Fielder XT guidewire and finally we thought that the Fielder XT guidewire successfully entered into the distal true lumen (Fig. 3A), since this was confirmed by angiography with feeling of free motion in the distal tip of the wire. And then, sequential ballooning with a 1.5 mm × 10 mm Amadeus Supercross® and 2.0 mm × 15 mm Sapphire II® was done (Fig. 3B). Immediately after the ballooning, cineangiogram showed the formation of a huge AVF arising from the distal LCX artery draining into coronary sinus via the PVLV with side branches (Fig. 4). Although the patient's vital signs were stable and the patient did not complain of ischemic chest pain, we decided to seal the newly developed AVF due to the relatively bigger size of the AVF following ballooning

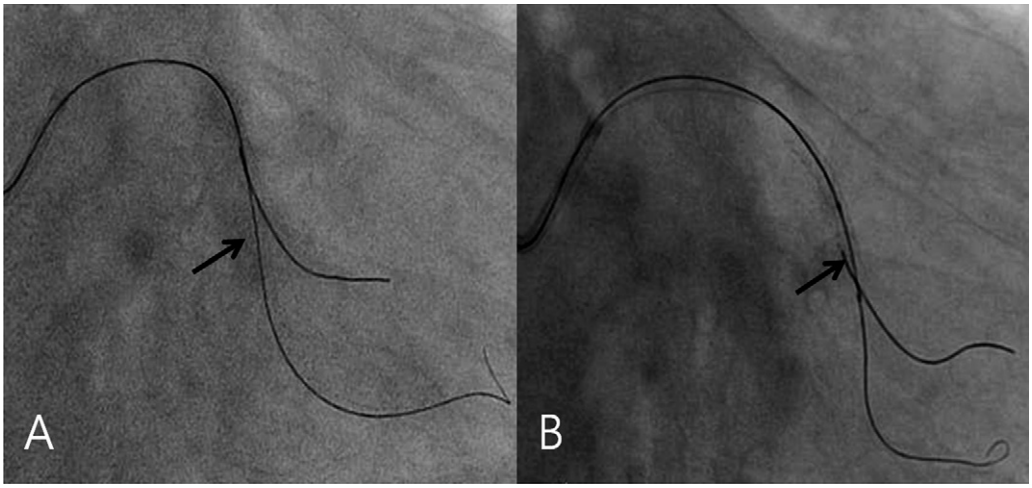

Figure 3. (A) We confirmed that the Fielder XT guidewire successfully passed across into true lumen of the distal left circumflex artery (arrow). (B) Sequential ballooning with a 1.5 mm × 10 mm Amadeus Supercross® and 2.0 mm × 15 mm Sapphire® was done (arrow).

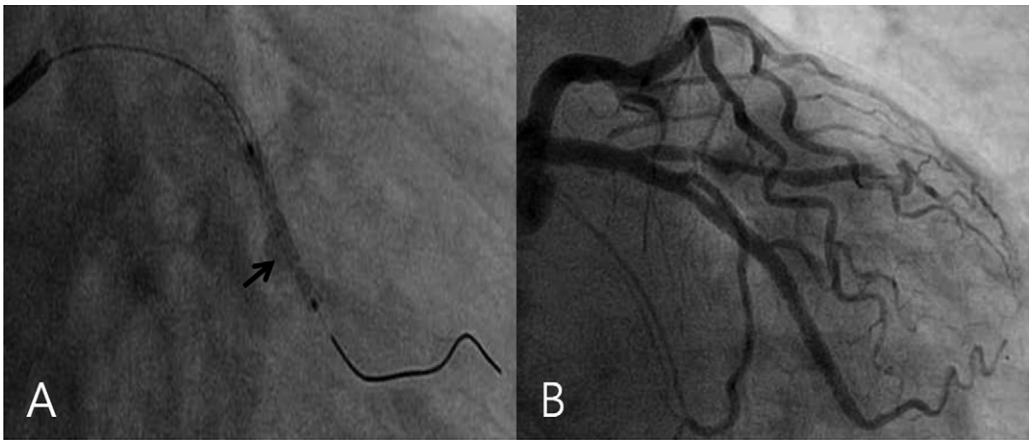

Figure 5. (A) 3.0 mm × 19 mm polytetrafluoroethylene-covered stent (arrow) was positioned and deployed in bifurcated site of the distal left circumflex artery and obtuse marginal artery branch. (B) Final angiography showed no visible arteriovenous fistula.

for the patient's safety. To seal off the AVF, a 3.0 mm × 19 mm polytetrafluoroethylene (PTFE)-covered stent (Grafmaster, Abbott Vascular, Inc., Redwood City, CA, USA) was deployed at the bifurcated site of the distal LCX and OM branch (Fig. 5A). Subsequently, a 2.75 mm × 24 mm Nobori stent balloon was positioned inside of the covered stent and inflated to 14 atm for adjuvant ballooning to achieve complete sealing of the AVF. Repeated angiography showed no visible previous iatrogenic AVF (Fig. 5B).

Discussion

Iatrogenic coronary AVF is an extremely rare complication of PCI. The majority of iatrogenic coronary AVF caused by PCI involve communications between the coronary arteries and the cardiac chambers such as the right ventricle, and less commonly, the left ventricle [1,2].

There are several case series for iatrogenic coronary AVF into cardiac vein associated with PCI [3–5]. We described a case of an iatrogenic coronary AVF from the distal LCX artery to the PVLV as a complication by penetration of CTO guidewire (Fielder XT) from LCX artery into cardiac vein (PVLV) and balloon angioplasty, which was treated successfully with a PTFE-covered stent. Aforementioned, to our knowledge, this is the first reported case of an iatrogenic LCX-to-PVLV fistula formation and management following CTO intervention.

On the other hand, preventing the complications of PCI is one of the most important issues. The angiography with feeling of free motion in the distal tip of the wire was shown and guidewire was easily advanced into far-distal LCX without resistance. So we thought the guidewire had successfully reached into the true lumen of the distal LCX. Nevertheless, there was a mistake in our procedure; the ballooning with 2.0-mm balloon catheter was done without angiographic confirmation shortly after the balloon angioplasty using a 1.5-mm balloon catheter. Further, because there were no obvious collaterals from LAD or RCA into LCX, we could not definitely identify whether the guidewire had successfully reached into the true lumen of distal LCX. In this situation, we should have paid more attention before using larger ballooning. If angiography was done shortly after small balloon angioplasty, iatrogenic AVF might have not occurred. We would like to emphasize that the operator should pay attention in a step-by-step manner during complex angioplasty to prevent this kind of unexpected complication.

Until now, the intraprocedural management of a coronary AVF resulting from PCI has not been established and was case by case due to a very rare incidence. There are few published series of iatrogenic coronary AVF to cardiac vein that developed following PCI. Elghoul and Leesar [3] described the case of an iatrogenic coronary AVF from the LAD artery to the anterior interventricular vein as a complication of stent deployment. In this case, the AVF was successfully closed, after implantation of a covered stent. Also, Kiernan et al. [4] reported the case of coil embolization of an iatrogenic coronary AVF to cardiac vein after rotational atherectomy. In this case, coronary AVF occurred after rotational atherectomy but as the patient was hemodynamically stable and pain free, the procedure was just stopped. However, two months later, heart failure developed. Oesterle et al. [5] reported percutaneous in situ venous arterialization-percutaneous in situ coronary venous arterialization with the use of a novel catheter-based system in a patient who had CTO of the LAD artery. However, 2 of the 5 patients had catastrophic complications and died within 48 h of the procedure.

On the other hand, sometimes, iatrogenic coronary AVF may spontaneously be resolved. Korpas et al. [1] described a fistula between the LAD and the right ventricle (RV) after stenting of a CTO lesion in the LAD. Since the patient was hemodynamically stable, medical therapy was continued; angiography after 6 months showed evidence of in-stent restenosis and disappearance of the AVF. Wilsmore and Gunalingam [6] reported spontaneous closure of iatrogenic coronary AVF arising from PCI for LCX lesion.

In our case, we thought that the newly formed iatrogenic coronary AVF would not spontaneously close since the AVF size was relatively big following 2.0 mm balloon angioplasty after stiff CTO guidewire penetration and there existed a large amount of the shunt visualized by coronary angiography, despite the patient's vital signs being stable shortly after the occurrence of AVF and the patient was asymptomatic. We assumed that coil embolization was not suitable for this particular case due to larger venous system connected from LCX artery and considered the covered stent as the first option.

Conclusion

We report a case of a huge iatrogenic LCX-to-PVLV fistula formation resulting from a complication during CTO intervention, which was successfully closed by a covered stent deployment. We recommend performing the closure of iatrogenic AVF if fistula size is big enough for preventing future events including advanced heart failure even if a patient is asymptomatic at index procedure. Since controversies still exist concerning the closure of iatrogenic AVF in asymptomatic patients, we need additional studies with larger study population with long-term follow up.

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